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Gavrilov, Y V ; Valko, P O

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Corresponding Author:	Philipp O Valko, M.D. University Hospital Zurich Zurich, SWITZERLAND
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	University Hospital Zurich
Corresponding Author's Secondary Institution:	
Corresponding Author E-Mail:	philipp.valko@usz.ch
First Author:	Yury V Gavrilov
First Author Secondary Information:	
Order of Authors:	Yury V Gavrilov
	Philipp O Valko, M.D.
Order of Authors Secondary Information:	
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Reply to reviewer

A very welcome addition to Pioneers. Would you be kind enough to make the following minor revisions prior to acceptance?

- p2, line 2: for "sank" read "sink". *Thank you – we have changed the wording accordingly.*

- p2, line 43: perhaps a few words of explanation on "ordinator"? Is that equivalent to resident, or intern? *We apologize – we should have understood that the Russian system of postgraduate education in medicine is barely known outside of Russia. Ordinatura is the Russian equivalence of clinical residency. Today, the differentiation of younger ordinator and elder ordinator is usually not made anymore. The system of ordinatura has been established early during the period of the Soviet Union (around 1946), but we couldn't find convincing documents that the same naming had existed already during Kernig's lifetime. Therefore, we decided to replace "younger ordinator" by intern, and "elder ordinator" by senior physician.*

- p3, line -1: "in first instance" to read "in the first instance". *Thank you – we have changed the wording accordingly.*

- p4, line 2: "indicates" to read "indicating". *Thank you – we have changed the wording accordingly.*

- p4, line 48: "cannot adequately" to read "cannot be adequately". *Thank you – we have changed the wording accordingly.*

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Vladimir M. Kernig (1840-1917)

Yury V. Gavrilov[1], Philipp O. Valko[2]

[1] *Department of General Pathology and Pathological Physiology, Institute of Experimental Medicine, Saint Petersburg, Russia*

[2] *Department of Neurology, University Hospital Zurich, Switzerland*

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Correspondence to:

Yury V. Gavrilov, MD, PhD
Department of General Pathology and Pathological Physiology, Institute of Experimental Medicine, St. Petersburg, Russia.
E-mail: yury-doctor@mail.ru

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Few figures in medical history are remembered for one single contribution yet otherwise sink almost completely in oblivion. Such an example is Vladimir Mikhailovich Kernig (1840-1917), famous for his description of a sign of meningeal irritation in 1882 that has since been referred to as Kernig's sign. Three decades after his death, Russian biographers already complained that virtually nothing was known about the life of their compatriot [6, 7, 9].

Vladimir Kernig was born on June 16, 1840, in Liepaja (Latvia), and studied medicine at the University of Tartu, an ancient Estonian city that used to be known at that time under the name of Dorpat (German) or Derpt (Russian). His most influential teacher was Adolf Wachsmuth (1827-1865), a German physician and former director of the Medical Department in Göttingen, who later devoted himself to psychiatry and eventually was appointed to the newly created chair of psychiatry at the University of Tartu. Soon after his graduation in 1864, Kernig moved to Saint Petersburg, where – as it appears – he spent his entire life. When Kernig died on April 19, 1917, at the age of nearly 77 years, the city's name had already been changed to Petrograd; he was buried at Smolensk Lutheran Cemetery, which had also become the final resting place for such illustrious European scientists as Swiss mathematician Leonhard Euler (1707-1783), Spanish engineer Agustín de Betancourt (1758-1824), and German physicist Moritz von Jacobi (1801-1874).

According to the 1889 Album Academicum of Dorpat University, Kernig worked from 1864 as intern and from 1867 as senior physician at Obuchow Hospital in Saint Petersburg, and from 1873 he was simultaneously active at the Empress Marie's Institution, a school for the deaf and mute. A man of social engagement, Kernig contributed to the organization of higher female medical education in Russia, gave lectures in internal medicine at Obuchow Women's Hospital (1881-1886), and acted as chairman of the Society of German doctors in Saint Petersburg. In 1890, Kernig was elected head physician at Obuchow Hospital, where he remained active until World War I.

Kernig was in the first instance a specialist in internal medicine and infectious diseases. Among other works, Kernig published “On splenic abscess after relapsing fever” in 1867, “On subfebrile states of considerable duration” in 1879, and “Acoustic attenuation at pulmonary apex auscultation despite absence of pathological alterations” in 1898. His interest in problems of the nervous system, however, became obvious very early in his career, as reflected by his doctoral thesis on thermoregulation (“On experimental contributions to our knowledge of warm-regulation in man”), which he successfully defended still in Tartu immediately after his graduation.

During the process of medical history taking, Kernig registered for the first time that patients suffering from bacterial or tuberculous meningitis, while sitting on the edge of the bed, were not able to fully extend their knees. In the following three decades, Kernig extensively and persistently investigated this clinical sign [5], and in 1882 he reported his observations on this “little noted symptom of acute meningitis” at a medical congress in Saint Petersburg [3]. In 1884, he presented his discovery at the International Medical Congress in Copenhagen, Denmark, and published it in the same year in the *Berliner Klinische Wochenschrift* [4]. Kernig considered his sign to be positive when the knees could not be extended more than 135°, and in very pronounced cases patients could not overcome a right angle. He realized that the clinical severity of meningitis was not always associated with the extent of the flexion contraction. In severe cases, Kernig occasionally noted a similar flexion contraction also in the elbows. Remarkably, Kernig never regarded pain as a characteristic feature; on the contrary, he wondered at the frequent indolence of his sign [3]. Moreover, and again in contrast to how we perform and interpret this maneuver today, Kernig used to emphasize that the flexion contraction of the knees became most apparent when patients were examined in the sitting position with their legs dangling, whereas the sign was often less pronounced or even absent in supine position and typically disappeared when patients stood up. “…*the difference between the entire absence of the contraction in the supine position and its presence in the sitting position is so remarkable that it is worthwhile to pay particular attention to this symptom and to look for it in every case*.” [3]. Today, Kernig’s sign

is most commonly examined in the supine patient with a 90° hip flexion, and resistance to knee extension with lower lumbar or posterior thigh pain indicating a positive test. It is believed that Kernig's sign represents a protective reaction to avoid painful stretching of inflamed meninges and spinal nerve-roots [8].

Kernig also described the transient disappearance of his sign following lumbar puncture. In the case of simultaneous central hemiparesis, the flexion contraction was typically less pronounced or entirely disappeared on the side of hemiparesis, which may represent a particularly meaningful observation in unconscious patients [5]. Kernig was aware that a positive sign could be found not only in infectious meningitis but in any condition with meningeal irritation, including increased intracranial pressure, chronic CNS inflammation or after subarachnoid haemorrhage. Intensity of neck stiffness and flexion contraction in the knees were not always of equal degree, but a mild Kernig's sign usually excluded severe neck stiffness. As an exception, Kernig observed that in tuberculous meningitis with paraplegia and marked flexion contraction of the knees, nuchal rigidity may be missing. During recovery from meningitis, Kernig's sign often took longer to disappear than all other meningeal symptoms.

When Josef Brudzinski (1874-1917) described his nape of the neck sign in 1909, he at once claimed superiority over Kernig's meningeal sign [2]. Over the following decades, clinicians established the clinical value of both meningeal signs, although sensitivity for meningitis seems equally low in both tests [1, 10]. Today, Kernig's sign remains a frequently performed clinical maneuver in patients with suspected meningitis, and is particularly helpful in patients in whom neck stiffness cannot be adequately examined due to orthopedic or other reasons.

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Figure
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